Space Weather Technical Forecast

Issued on Monday, 30 May 2022 at 13:25 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Slight chance of M-class flares. Active electron fluence expected by 02 June.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low with one C-class flare emanating from ex-3019, a faded, now plage region in the northwest quadrant. The flare was associated with a filament eruption and an analysis will be undertaken when sufficient imagery is available to determine if it is Earth-directed. AR3025 (Dao/Beta) and a new unnumbered region (Cro/Beta) are developing in the far northwest quadrant but have not produced any significant activity. Two alpha regions in the southeast, 3023 and 3024, are considered to be benign. No Earth directed CMEs have been observed in coronagraph imagery in the last 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind, as observed at L1, has averaged around 550km/s over the last 24 hours as the Earth progresses through the high speed stream from coronal hole 84. Density has been close to average throughout this time. Total magnetic field strength has been weak, with the north-south component varying weakly. Phi angle was predominantly negative (towards the Sun). Geomagnetic activity was mainly Quiet to Unsettled, but increased to Active between 29/1500-1800 UTC.

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) has been at background levels throughout the past 24 hours. The high energy electron flux (greater than 2 MeV) was at background levels initially, but increased to occasionally high levels through the period, reaching 2210 pfu at 30/1100 UTC. Electron fluence rose sharply, reaching 1.94e7 integrated pfu at 29/2400 UTC and then 6.38e7 integrated pfu at 30/1200UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be mainly Low or Very Low, but with a slight chance of M-class flares. Initially this will be due to AR3017 just beyond the western limb, but also due to returning region ex-3006 which is expected to rotate onto the eastern limb in the next 24 hours.

Solar Wind / Geomagnetic Activity: A CME which left the Sun on 28 May could glance the Earth on 01 June, but with low confidence and low probability. Earth is currently transitioning through the high speed stream from coronal hole 84, with this expected to ease by day 3 (01 June). No further high speed streams are then expected to connect with Earth. Geomagnetic activity is expected to be mainly Quiet with isolated Unsettled spells. There is a risk of Active or G1/Minor Storm intervals through days 1 and 2 in any sustained periods of negative Bz, with this risk continuing into day 3 (01 June) due to the very slight chance of a CME arrival.

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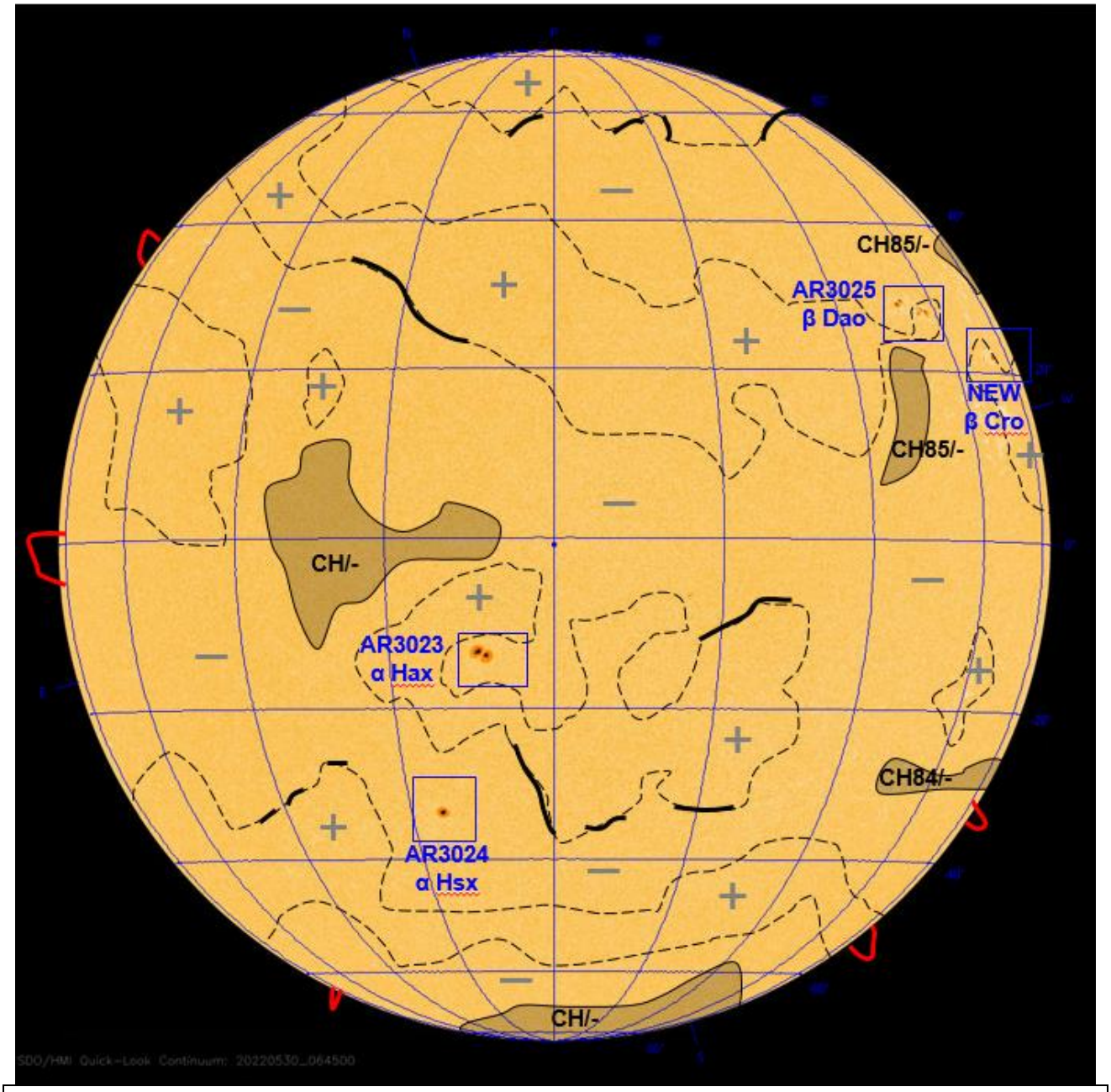
Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is expected to be at Background levels during this period. High energy electron flux (greater than 2MeV) is expected to be at mainly moderate to high levels, with a likelihood of more persistently high (1e3 pfu) levels through days 3 and 4. Electron fluence levels are forecast to follow an increasing trend and are expected to reach the Active (1e8 integrated pfu) threshold by the end of the period.

Figure 1. Solar Analysis Valid 30/0800UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

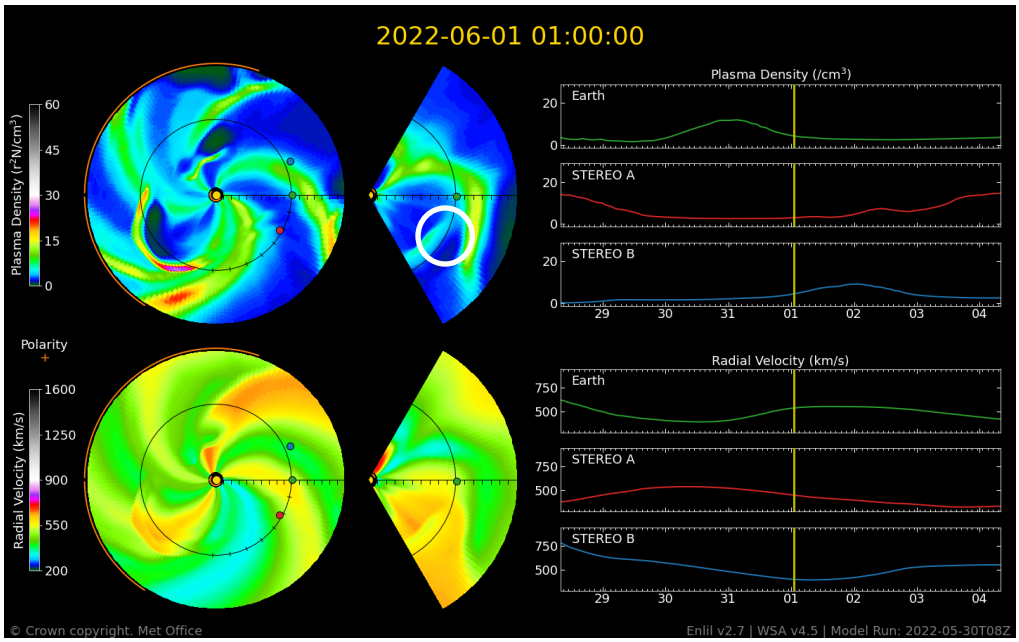
A CME which left the Sun on 28 May is due to pass to the south of the Earth on 01 June, but there is a very slight chance of a glancing blow.

Earth is currently in the high speed stream from coronal hole 84 with solar winds elevated at between 500-550km/s. This is then due to ease through the next two days, as the coronal hole rotates around the western limb. No further coronal holes are due to connect during the forecast period.

Geomagnetic activity is expected to be mainly Quiet with isolated Unsettled spells. There is a risk of Active or G1/Minor Storm intervals through days 1 and 2 in any sustained periods of negative Bz, with this risk continuing into day 3 (01 June) due to the very slight chance of a CME arrival.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	1	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: MOSWOC Enlil, showing predicted passage of 28 May CME (circled). The Earth is the green dot just above the circle.



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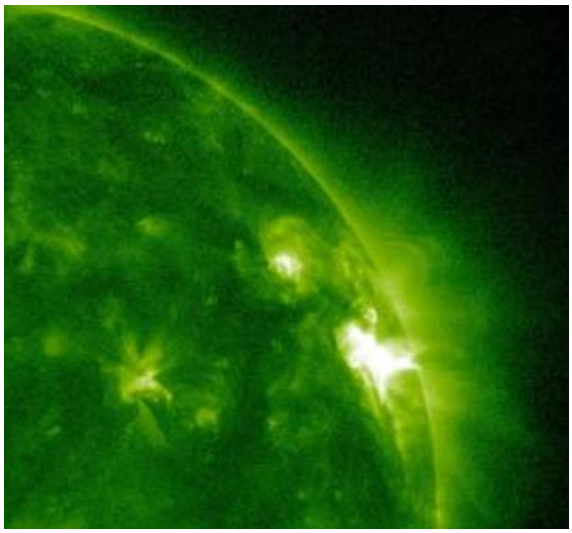
Radio Blackouts - X-Ray Flares:
Solar activity is expected to be generally Low or Very Low over the next four days, with no significant active regions on the visible disc. AR3025 (Dao/beta) has developed over the last 24 hours, but has not produced any significant flare activity. A new region closer to the northwest limb is classified as Cro/Beta. Ex-3019 produced a filament eruption and a C1.5 flare which may have led to a CME, with this event due to be analysed.

Ex-3017, beyond the western limb is now considered to be a low risk for any flares from above the limb. However a bright flux region is due to rotate onto the southeast limb in the next 24 hours. This region corresponds to ex-3006, which produced an X1.5 flare on the previous rotation and may have been responsible for a recent large far-sided CME. Based on the potential risk from this region, the probability for M-class flares is raised above that suggested from visible active regions.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	10	10	10	10
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: Flare from region ex-3019 on SDO AIA-94 imagery at 30/0227 UTC. The resulting filament eruption will be analysed for a potential Earth-directed component.



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Solar Radiation Storms - (High Energy Protons):
The high energy proton flux (greater than 10 MeV) is at background levels and is most likely to remain so through the period. The return of ex-3006 may lead to an elevated risk, but currently the region is monitored for any significant activity.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):
High energy electron flux (greater than 2MeV) values are currently oscillating between moderate and high levels, with a recent sharp rise probably due mainly to the effects of the high speed stream on the shape of the radiation belts. Periods of enhanced geomagnetic activity may also be causing displacement of electrons within the belts. The high speed stream is due to subside by day 3 or 4 (01 or 02 June) which may result in the electron flux reaching higher peaks on diurnal highs and also maintaining a higher average value between peaks.

Electron fluence continues to rise sharply with an increased chance of reaching the Active (1e8 integrated pfu) threshold by day 3 or 4 due to the increase in electron fluence.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	30	40	50	70
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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Figure 4: GOES 16 electron flux (top) and MOSWOC REFM model (bottom)

NOTE: Our REFM model has been upgraded and has changed in appearance. The two main changes are the option to include a recurrence graph, which traces what happened on during last solar rotation for comparison and potential expectation in the coming 3 days (each plot is the observation from T-minus 28 days). Also, the cadence of REFM forecast fluence data is reduced past day 1 to only one value per day. The cadence remains 3-hourly for the first 24 hours.

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